Dissolved Oxygen (DO) Protocol

Purpose

To measure the amount of oxygen dissolved in the water sample

Overview

Dissolved oxygen is closely related to survival of plant and animal life in all bodies of water. It is affected by natural processes and by human activities.

Time

15 minutes for calibration
15 minutes in the field

Level

Intermediate and Advanced

Frequency

Weekly

Calibration every six months

Key Concepts

Dissolved oxygen
Comparing with a standard
Accuracy, Precision

Skills

Using the dissolved oxygen test kit properly
Recording data

Materials and Tools

Dissolved Oxygen Kit (See *Toolkit*)
Safety note: This kit contains hazardous chemicals
Distilled water
250-mL polyethylene bottle with top
Thermometer
Data Work Sheets
Latex gloves/safety goggles

Preparation

Practice sample preparation and preservation procedure given in this protocol.

Bring the tools and materials to the Hydrology Study Site.

Prerequisites

None

Calibration and Quality Control

Calibration should be performed every six months to verify your technique and the integrity of your chemicals.

1. Rinse a 250 mL bottle twice with distilled water. Measure 100 mL of distilled water with a graduated cylinder.
2. Pour this water into the 250 mL bottle. Put the lid on tightly and shake it vigorously for 5 minutes.
3. Uncap the bottle and take the temperature of the water. Be sure the tip of the thermometer does not touch the bottom or sides of the bottle. Wait 1 minute before reading the temperature.
4. Record the temperature on the Hydrology Investigation Data Work Sheet.
5. Follow directions to measure dissolved oxygen.

On the data sheet, record the value as mg/L DO for the distilled-water standard. The mg/L DO found using the shaken standard must be within 0.4 mg/L of the expected value for a shaken (thus saturated with oxygen) distilled water sample. To find the expected value for a saturated DO distilled water sample:

1. Look up the temperature of your standard in Table HYD-P-1.
2. Look at the corresponding solubility of oxygen (mg/L) and record it on the Calibration Data Work Sheet.

Table HYD-P-1: Solubility of Oxygen in Water Exposed to Air at 750 mm Hg Pressure

Temp °C	Solubility mg/L	Temp °C	Solubility mg/L	Temp °C	Solubility mg/L
0	14.6	16	9.9	32	7.3
1	14.2	17	9.7	33	7.2
2	13.8	18	9.5	34	7.1
3	13.5	19	9.3	35	7.0
4	13.1	20	9.1	36	6.8
5	12.8	21	8.9	37	6.7
6	12.5	22	8.7	38	6.6
7	12.1	23	8.6	39	6.5
8	11.9	24	8.4	40	6.4
9	11.6	25	8.3	41	6.3
10	11.3	26	8.1	42	6.2
11	11.0	27	8.0	43	6.1
12	10.8	28	7.8	44	6.0
13	10.5	29	7.7	45	5.9
14	10.3	30	7.6	46	5.8
15	10.1	31	7.4	47	5.7

Example: a standard temperature of 22° C has a corresponding DO solubility of 8.7 mg/L.

3. Look at the Calibration Value in Table HYD-P-2 corresponding to your elevation in meters and record it on the Calibration Data Work Sheet.
   Example: An elevation of 1,544 meters has a corresponding saturation calibration value of 0.83.
4. Multiply the solubility of oxygen found in Step 2 by the calibration found in Step 3.
   Example: At an altitude of 1,544 meters and a temperature of 22° C, you multiply (8.74 mg/L) x (0.83) = 7.25.
5. This value (7.25 in the example) is your expected value for a shaken distilled water standard.
6. Compare this value to the value for DO that you found when you tested your shaken, distilled water standard. If the value is not within 0.4 mg/L (LaMotte kit) or 1 mg/L (Hach kit), try the measurement again on the distilled water. If it is still off, but by less than 1 mg/L, record the DO value on the Calibration Investigation Data Work Sheet.
7. If you get a difference of more than 1 mg/L, report the value you get and replace the chemicals in your test kit before making more measurements. Recalibrate when you get fresh chemicals.

How to Measure Dissolved Oxygen

Sampling Procedure

1. Rinse the sampling bottle and hands with sample water three times. Rinse vial three times in distilled water.
2. Replace the cap on the bottle.
3. Submerge the bottle in sample water and remove the cap. Allow the container to fill.
4. Tap the bottle to release air bubbles.
5. While the bottle is submerged, replace the cap. Remove the capped bottle from the water.
6. Check to ensure that no bubbles are present in the bottle. If bubbles are found, repeat the sampling procedure.

Sample Preservation and Testing Procedure

1. Use a dissolved oxygen test kit that meets the specifications in the Toolkit of the GLOBE Program Teacher's Guide. Follow the instructions carefully. If a scoop is used to measure powdered chemicals, do not allow the scoop to come in contact with the liquid.
2. Record the values from the student groups on the Hydrology Investigation Data Work Sheet.
3. Take the average of the DO values measured by the student groups. If the values are all within 1 mg/L of the average, submit the average DO value to the GLOBE Student Data Server. Otherwise repeat the measurement.
4. Put all liquids in waste bottle.

DO test kits involve two overall parts - sample preservation (stabilization) and sample testing. The preservation part involves the addition to the sample of a chemical that precipitates in the presence of dissolved oxygen, followed by addition of a chemical that produces a colored solution. The testing part involves dropwise addition of a *titrant* solution until the color disappears. The DO value is calculated from the volume of titrant added.

Table HYD-P-2: Calibration Values For Various Atmospheric Pressures and Altitudes

Pressure mm Hg	Pressure kPa	elev m	Calibration value %
768	102.3	-84	1.01
760	101.3	0	1.00
752	100.3	85	0.99
745	99.3	170	0.98
787	98.8	256	0.97
730	97.3	343	0.96
722	96.3	431	0.95
714	95.2	519	0.94
707	94.2	608	0.93
699	93.2	698	0.92
692	92.2	789	0.91
684	91.2	880	0.90
676	90.2	972	0.89
669	89.2	1066	0.88
661	88.2	1160	0.87
654	87.1	1254	0.86
646	86.1	1350	0.85
638	85.1	1447	0.84

Pressure mm Hg	Pressure kPa	elev m	Calibration value %
631	84.1	1544	0.83
623	83.1	1643	0.82
616	82.1	1743	0.81
608	81.1	1843	0.80
600	80.0	1945	0.79
593	79.0	2047	0.78
585	78.0	2151	0.77
578	77.0	2256	0.76
570	76.0	2362	0.75
562	75.0	2469	0.74
555	74.0	2577	0.73
547	73.0	2687	0.72
540	71.9	2797	0.71
532	70.9	2909	0.70
524	69.9	3203	0.69
517	68.9	3137	0.68
509	67.9	3253	0.67
502	66.9	3371	0.66